REMARKS/ARGUMENTS

Status of the Application

Prior to the entry of this amendment, claims 25-39, 42 and 45-54 were pending in this application. In the Office Action all claims were rejected under 35 U.S.C. § 102(b) and/or 35 U.S.C. § 103(a).

The present amendment cancels all previous claims. New claims 55-82 are now added and are presented for examination. No new matter is added by the amendments.

Nature of the amendments

In light of the rejections and comments in the Office Action, the previous claims are being replaced with a series of re-drafted claims. There are three independent claims 55, 68 and 71. These claims have been limited to *anionic* viscoelastic surfactants, further defined using language from original claims 10 and 11 and the paragraph at the top of page 14 where the text refers to typical carboxylates being derived from acids including oleic and erucic. Since these acids have chain lengths of 18 and 22 carbon atoms respectively, the independent claims now refer to a chain length in this range. Claims 56, 69 and 72 name specific groups.

Page 14 line 7 and claim 11 referred to dimers, trimers and oligomers of such acids. These are included by the third bullet point in the claims' definition of the anionic surfactants. These claims also include compounds of the formula RXYZ as referred to at page 14 line 13 and in claim 10 with some changes to the definitions of X and Y. The description on page 15 shows that X may be ester or amide, as is now required, and compound VII on page 15 is a dimer which is used in Example 1.

The original text of claim 10 also referred to *modified carboxylates*, but it appears that these modified carboxylates satisfied the definition of RXYZ and so the phrase concerned has been omitted as unnecessary repetition.

In claim 55, the hydrophilic-lipophilic compound is referred as *viscosity enhancing*. This is demonstrated by the examples as will be mentioned below. In addition in

claim 55, the amount of this substance is limited to at most half the molar amount of the anionic surfactant as taught at page 8 line 25.

Claim 55 and also claim 71 refer to *providing* a fluid and *injecting* this specified fluid into a wellbore. This is supported by page 6 line 8.

Independent claims 68 and 71 refer to the enhancement of viscosity at temperatures above ambient. The language of claim 68 comes from previous claim 46 and is also supported by page 6 lines 11 to 14. Claim 71 refers to the hydrophilic-lipophilic organic compound enhancing the viscosity over a range of elevated temperatures. This is shown by the examples and drawings. The values of 50 and 100°C. as the lower and upper ends of the ranges are taken from page 7 lines 1 and 10.

Support for the other claims is summarized in the following table

Claim number	Previous claim number	Support in the original text
56, 69, 72		Language adapted from claim 11 and page 8 lines 16-19
57, 73	49 in part	Language adapted from claim 11 and supported by page 15.
58 – 61, 70, 74-77	27 - 30	Claims 4 - 7
62		Foot of page 13
63		Claim 12 and page 12 line 27
64, 78	42	Claim 22
65, 79	53	Claim 19
66, 80		Page 5 line 22
67, 81	38 and 54	Claim 16
82		Page 7 line 10

Benefit of the invention as now claimed.

The examples and drawing figures show the beneficial results of the invention as it is now claimed.

It is generally the case that viscoelastic surfactants require some salt to be present in order to display the property of viscoelasticity and/or to retain it as temperature is increased. For some surfactants, including the cationic material EHAC, the percentage of salt in a fluid can be fairly low. Figure 1 shows 4wt% EHAC and 3wt% KCl achieving a viscosity over 100cP at 100 sec^{-1} up to a temperature of approximately 75°C. However, the anionic surfactants as now claimed were found to require larger quantities of salt. As can be seen from Figure 1, Potassium oleate requires 8wt% KCl to achieve similar properties. Figure 2 tells a similar story. The dimeric surfactant has a viscosity over 100cP at temperatures up to about 60°C if only 4wt% KCl is used, but maintains viscosity of this magnitude up to 120°C if 8wt% KCl is used.

The anionic surfactants of this invention have advantages and may be preferred over cationic surfactants in some circumstances. They are "greener" and may be used in a marine environment where fear of the harm caused by an accidental spillage militates against using EHAC. Secondly, when used in accordance with this invention good properties may be achieved at high subterranean temperatures.

Yet, if as shown by Figures 1 and 2 it is necessary to use a high percentage of salt, the choice of these anionic surfactants becomes uneconomic.

The present inventors have found that this requirement for a high percentage of salt, for these surfactants, can be overcome by including a modest proportion of a compound with hydrophilic and lipophilic properties, such as oleyl alcohol for instance. This is demonstrated in Figure 3. Adding oleyl alcohol in a 0.3 molar ratio to the surfactant, enhances the viscosity of the composition with only 4wt% KCl and extends the temperature range for viscosity over 100cP from 60°C up to almost 110°C. Thus the dotted plot in Figure 3 with 4wt% KCl and 0.3 molar ratio oleyl alcohol is rather similar to the dotted plot in Figure 2 with 8wt% KCl.

The improvements in relationships between temperature, viscosity and salt concentration can be stated in several ways which overlap, thus:

- reduced concentration of salt required, even if the temperature is elevated;
- useful viscosity, at an acceptably low salt concentration, even if the temperature is elevated;
- increase in the critical temperature, up to which viscosity remains usefully high, at an acceptably low salt concentration;
- the hydrophilic-lipophilic organic compound raises viscosity both at ambient and above-ambient temperatures, at an acceptably low salt concentration

35 U.S.C. §102 Rejections

Paragraph 9 of the Official Action states that a number of claims were rejected as anticipated or obvious over Whalen. Applicants contend that Whalen does not disclose all requirements of any of the present claims. The general distinction from Whalen is the requirement for specified anionic surfactants. None of the surfactants named in Whalen at column 3 lines 10 to 27 and at column 4 line 57 to column 5 line 10 come within the defined classes of anionic surfactants in claims 55 and 68.

As the Office Action has correctly pointed out, there is a reference to dicarboxylic acids at column 5 lines 25 to 28. These dicarboxylic acids are incompletely defined, and so there is no disclosure of aliphatic hydrophobic groups or of RXYZ structures within the definitions now present in the independent claims 55, 68 and 71. It is noted that these dicarboxylic acids are placed under a heading of *hydrotropic* surfactants, suggesting that they have different properties from the anionic surfactants listed earlier by Whalen and in turn implying that they do not have viscoelastic properties. Of course there can be no certainty about incompletely identified materials, but it cannot be presumed that these dicarboxylic acids are capable of forming a viscoelastic gel under any circumstances.

As the Office Action points out, the Zhou reference is concerned with wellbore fluids and names materials which individually meet requirements of the claims. However, this document does not teach those materials in the combination and proportions called for by the independent claims. Whilst the paragraph at the top of page 18 mentions that alcohol may be included to solubilise surfactant, these alcohols are an optional component generally used with cationic surfactants and not with anionic surfactants as now defined. Zhou presents alcohols as reducing viscosity (bottom page 18 and top line page 19) and so does not disclose *viscosity enhancing* by alcohol.

Turning to the examples in this document, anionic surfactants are exemplified in Example 5 onwards. None of these examples contains a lower alcohol used to solubilise the surfactant. Example 5 does include oleyl alcohol but it can be appreciated from the document as a whole that this example is not describing a composition intended to be injected into a wellbore and conveyed to a subterranean formation. The invention of Zhou is to formulate a fluid with two surfactants, relying on one to provide viscoelastic properties and relying on the other to undergo delayed hydrolytic cleavage below ground and thereby liberate a compound (which may be oleyl alcohol) which disrupts wormlike micelles and breaks a viscoelastic gel. Examples 6 and 7 are compositions according to the invention of Zhou. Example 5 is not, because it has only one surfactant. Plainly, example 5 is a piece of experimental work which has been included in Zhou to show that oleyl alcohol which is liberated by hydrolysis in the subsequent examples 6 and 7 will act to reduce viscosity.

Claims 68 is directed to increasing the temperature at which viscosity decreases. The method requires addition of a hydrophilic-lipophilic compound to enhance viscosity. Claim 71 requires that the hydrophilic-lipophilic compound increases viscosity at temperatures in a range above ambient. Zhou does not teach that an alcohol (either a lower alcohol such as isopropanol nor oleyl alcohol) can increase viscosity at any temperature. It is entirely silent about viscosity at elevated temperatures. Zhou teaches at the foot of page 18 and top of page 19 that alcohols reduce viscosity.

So in light of the above discussion:-

- All claims are distinguished from Whalen because Whalen does not teach an anionic surfactant as required by all independent claims.
- Claims 55 and 71 are distinguished from example 5 of Zhou because this is experimentation to demonstrate the effect of oleyl alcohol but does not disclose or suggest that its composition should be injected into a wellbore.
- Nothing else in Zhou (and nothing in Whalen) teaches anionic surfactant with hydrophilic-lipophilic compound in the proportion required by claim 55. So Zhou does not disclose the combination and proportions required by claim 55.
- Nothing in Zhou teaches enhancement of viscosity by means of a hydrophilic-lipophilic compound at elevated temperature, as called for by claims 68 and 71.

35 U.S.C. §103 Rejections over Whalen

In the official action the examiner contended that the claims then being examined were obvious over Whalen because differences from the disclosure of Whalen were considered to be minor.

The present claims define the anionic surfactants in a manner giving clear distinction from Whalen as has been discussed above. It is respectfully submitted that nothing in Whalen addresses or points towards issues arising with the anionic surfactants now claimed and consequently nothing in Whalen teaches or suggests the invention as now claimed.

In addition applicants still believe that Whalen achieves viscoelasticity by a mechanism other than the formation of wormlike micelles. The examiner's point that"identical compositions cannot have mutually exclusive properties" was well taken. However, the present claims call for solutions of micelles and the examples demonstrate use of surfactant in a single figure percentage is to form such micellar solutions. By contrast Whalen's examples use rather higher percentages of mixtures of materials and repeatedly refer to emulsions. There is also a

more general statement in column 4 line 1 of Whalen to fluids being typically in the form of an emulsion.

It is respectfully submitted that a skilled reader of Whalen will understand that document to be concerned with viscoelasticity obtained through emulsion formation and consequently would not expect the document have any relevance to viscoelastic micellar solutions formed from different surfactants.

So it is respectfully submitted that Whalen is no longer relevant on grounds of composition and would not be seen as relevant to viscoelasticity created through micellar solutions.

35 U.S.C. §103 Rejections over Zhou

Zhou teaches directly away from the present invention. It is the clear teaching of Zhou that alcohols reduce viscosity, whereas the present invention relies on hydrophilic-lipophilic compounds which may be alcohols to enhance viscosity. Nothing in Zhou teaches or suggests that a hydrophilic-lipophilc compound as required by the present invention will increase viscosity and benefit the relationships with salt concentration and temperature as is demonstrated in the examples and drawings.

It is noted that paragraph 11 of the Official Action placed reliance on Zhou's disclosure of isopropanol together with cationic surfactants. That is rendered moot by the requirement of the present claims for anionic surfactant.

CONCLUSION

In view of the foregoing, Applicants believe all claims now pending in this Application are in condition for allowance. The issuance of a formal Notice of Allowance at an early date is respectfully requested.

In the event that a fee or refund is due in connection with this Amendment, the Commissioner is hereby authorized to charge any underpayment or credit any overpayment to Deposit Account No 19-0615. If the Examiner believes a telephone conference would expedite prosecution of this application, please telephone the undersigned.

Respectfully submitted,

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